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ABSTRACT

Since 1985, the students in grades 2-8 in three selected elementary schools in Palau have been tested on basic math skills. This report describes the data collected in May 1993 and indicates the relative strengths and weaknesses of students at each grade level in each school. Major outcomes include: (1) the students at Harris School scored significantly higher than their counterparts in the other schools; (2) girls scored significantly higher than boys; (3) the recall of division facts was the skill most highly correlated to total test score in grades 5-6; (4) division computation was the skill most highly correlated to total test score in grades 7-8; (5) in spite of scoring lower in other areas, the students at Maris Stella scored significantly higher on solving word problems; and (6) a factor analysis revealed that the ability to solve word problems is related to the abilities to solve percent and algebraic equations, to convert one measurement unit to another, and to find the perimeter of a rectangle. Results of the testing are displayed in 13 tables. (Author/LL)

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ED 361 334

1993 Report to the Palau Ministry of Education on the Mathematics Project at Harris, Maris Stella, and Meyuns Elementary Schools

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Abstract

Since 1985 the students in selected elementary schools in Palau have been tested on basic math skills. This report describes the data collected in May, 1993. Students in Grades 2-8 in three elementary schools in Palau were tested on basic math skills. The results indicate the relative strengths and weaknesses of students at each grade level in each school. Major outcomes included: (1) the students at Harris School scored significantly higher than their counterparts in the other schools; (2) girls scored significantly higher than boys; (3) the recall of division facts was the skill most highly correlated to total test score in grades 5-6 ; (4) division computation was the skill most highly correlated to total test score in grades 7-8; (5) in spite of scoring lower in other areas, the students at Maris Stella scored significantly higher on solving word problems; and (6) a factor analysis revealed that the ability to solve word problems is related to the abilities to solve percent problems, to solve algebraic equations, to convert one measurement unit to another, and to find the perimeter of a rectangle.

Introduction for ERIC Readers

Palau is a nation of about 200 islands located in the western Pacific Ocean south of Guam, east of the Philippine Islands, and north of New Guinea. For the last 450 years Palau has been ruled by foreign nations, including Spain (1543-1898), Germany (1898-1914), Japan (1914-1947), and the Trust Territory of the Pacific Islands under the administration of the United States (1947 to the present). After being governed for more than 30 years by the United States, the districts of Micronesia which comprised the Trust Territory sought political independence. Saipan became a commonwealth; Yap, Truk, and Ponape joined together to form the Federated States of Micronesia; and the Marshall Islands became a nation. Only Palau has failed to negotiate a settlement with the United States; in seven plebiscites the people of Palau have failed to ratify a treaty. Negotiations are still underway, but in the meantime Palau became responsible for its own educational system for the first time in its history. The study reported below is part of an ongoing project to monitor the mathematics achievement of students in Palau during the transition to independence and local control.

Summary of 1993 Testing

History

This series of tests has been administered to students at Harris School since 1985. Meyuns was first tested in 1987 and Maris Stella was tested for the first time in 1993. In previous years, only grades 2-6 were tested, but in 1993 the seventh and eighth graders were also tested. The 1993 tests differed from previous tests in several ways. For grades 2-6, the categories or math skills tested remained the same but the number of problems was increased. The emphasis has been upon computational skills. Seventh and eighth graders were tested for the first time in 1993. In addition to computational skills, students were tested on a variety of math skills from the seventh and eighth grade curriculum.

Results from Previous Years

From 1985 to 1990 the tests at Harris School showed a steady decline. In 1991 the scores rebounded slightly, and in 1992 the scores remained about the same. The scores at Meyuns School increased from 1987 to 1990, decreased slightly in 1991, then remained about the same in 1992. Since the High School Entrance Exam scores have also declined since 1985, there is reason to be concerned about the math achievement of students in Palau. It is hoped that this longitudinal study will contribute to an eventual increase in math achievement scores in Palau.

Main Results of the 1993 Testing

1. In grades 2-6, Harris School scored significantly higher than the other schools, girls scored higher than boys, and the second graders at Harris School scored significantly higher than students in the other schools. There were no significant differences at the other grades.
2. The fifth and sixth grade students at Maris Stella scored significantly higher on solving word problems than their counterparts at the other two schools.
3. Of all the skills on the grades 5 - 6 test, the recall of division facts is most highly correlated with total test score.
4. This year's seventh graders at both Harris and Meyuns scored higher than they did last year as sixth graders, indicating that the students are making steady progress.
5. The eighth graders at Harris outperformed their counterparts in the other schools. The differences at the seventh grade were not significant.
6. Seventh and eighth grade girls outperformed the boys.
7. Of all the skills on the 7-8 test, computation with division is most highly correlated with total test score.
8. The seventh and eighth grade students at Maris Stella scored significantly higher on word problems.
9. Both correlations and a factor analysis show that the ability to solve word problems is related to the abilities to solve percent problems, to solve algebraic equations, to convert from one measurement unit to another, and to find the perimeter the a rectangle.
10. A principal factor analysis revealed that Computation Skill, Fractions Skill, and Problem Solving Skill were three factors of math ability.

Introduction

Purpose of the Testing

The purpose of this longitudinal testing program is to monitor the basic skills proficiency of students in Harris, Maris Stella, and Meyuns Elementary Schools over a period of years. That is, to determine if, over the long run, achievement scores are increasing or decreasing. Harris School has been tested in 1985, 1987, 1990, 1991, 1992 and 1993; Meyuns has been tested in 1987, 1990, 1991, 1992, and 1993. Maris Stella was tested this year for the first time. From 1985 through 1992 only the students in grade 2 through grade 6 were tested. This year, 1993, students in grade 7 and grade 8 were also tested.

The results of the test for grades 2 through 6 are presented in the tables beginning on page 16. By looking across the rows, a comparison can be made of student achievement in consecutive years. However, since the test in 1993 is different from the tests used in previous years, a direct comparison cannot be made between 1993 and the previous years.

The results can be helpful to teachers. By looking at the tables, teachers can determine how well their students are doing compared to students in other schools. The results can also be useful to planners who are concerned with the long-range improvement of mathematics achievement in Palau. Achievement scores at Harris School have declined since the test was first administered in 1985. During this same period of time the Palau High School Entrance Exam scores have also declined. Efforts are currently underway to correct these conditions. The testing done in this program is part of the larger effort to improve mathematics achievement in Palau.

Nature of the Test

The test which is being used at Harris, Maris Stella, and Meyuns Schools requires students to write the correct answers to a variety of problems in a limited amount of time. The second graders are tested on addition; the third graders on addition and subtraction; the fourth graders on addition, subtraction, and multiplication; the fifth graders on addition, subtraction, multiplication,

division, and word problems; the sixth graders on addition, multiplication, division, word problems, decimals, and fractions; and the seventh and eighth graders are tested on the four basic operations and a variety of topics covered at their respective grade levels. All levels of Bloom's Taxonomy of Educational Objectives are involved: recall, comprehension, application, analysis, synthesis, and evaluation.

The tests are timed because the automatic recall is important in mathematics, just as the automatic recall of the alphabet is important in spelling and writing. It measures the extent to which the individual student has mastered the basics of arithmetic. This is the first step towards being competent in mathematics.

Word problems are included in the test to see how well the students can solve such problems. The problems are of four types. The first type requires just one computation; the second requires two computations; the third three; and the fourth requires four computations. Although the latter types are very difficult, some of the sixth graders in Palau have solved all of these problems. This shows that the goal is not an impossible one.

Previous Results

The 1985 - 1990 Results

In September 1990 a 35-page report was prepared for the Ministry of Education on the testing activities at Harris and Meyuns Schools covering the time span from 1984 through 1990. [That report is now a part of the ERIC system - ERIC Reproduction Service No. ED 330643]. In that report it was noted that the students at Meyuns School had improved in their performance from 1987 to 1990. The scores of the students at Harris School, on the other hand, had steadily declined from 1985 to 1987 to 1990. Since mathematics scores on the Palau High School Entrance Examination had also declined during these years, it was crucial that the students be tested again in 1991 to determine if this downward trend at Harris School would continue.

The 1991 Results

In July 1991 another report was prepared for the Ministry of Education on the testing done at Harris and Meyuns Schools in May, 1991. The data showed that the scores had declined at Meyuns School in all grade levels except the sixth where the scores increased from 80% to 83%. The scores at Harris School were more encouraging, especially at the sixth grade level where scores increased on nearly all subskills. Scores also increased at all grade levels except the third. Hence, unlike the previous year in which scores were increasing at Meyuns and decreasing at Harris, the reverse was true in 1991. (Refer to the Tables 1 and 2 for more details.)

The 1992 Results

In May of 1992 the tests were once again administered to the students in grades 2-6 at Harris and Meyuns schools. In general, the results showed that the scores at Harris and Meyuns remained about the same as in 1991. No significant changes occurred.

The 1993 Tests

The Ministry of Education Mathematics Staff assisted in administering and scoring the exams. The tests were given back to the teachers several days after the tests were administered so that teachers could immediately go over the test with their students. The testing took two basic forms. Each of the grade 2 through grade 6 tests were of a similar format, and the seventh and eighth grade tests had identical formats. Therefore, the results will be discussed according to the two types of tests administered.

Grade 2 through Grade 6 Tests

In 1993 three changes were made in the tests for grade 2 through grade 6. (Copies of the tests are available upon request.) First, the number of facts to recall in one minute was increased from 30 to 42 for addition, subtraction and multiplication and from 30 to 40 for division. In previous years many students got all 30 correct, and so by increasing the number of problems it was possible to challenge the more able students and to obtain a better range of scores. Second, in

previous years students were given two minutes to complete six computational problems, the problems increasing in difficulty from simple to complex. In 1993 students were given five minutes for each computation subtest. There were 35 problems for addition, subtraction, and multiplication, 28 division problems at the fifth grade, and 22 division problems at the sixth grade. [There was a different number of problems at the upper grades because the problems were more difficult and took more space on the page.] This enabled students to better demonstrate their computational skills. And thirdly, the number of word problems was increased from four to eight. As in previous years, students were allowed eight minutes to complete the word problems. The number of problems given for each math skill at each grade level (grades 2-8) appear in Table 1 on page 18.

Results for Grade 2 through Grade 6

Harris School

Table 2 (on page 19) summarizes the results at Harris School for 1993. The table also contains the averages from all previous years of testing. The total score is the average of all subskill scores for a given grade level. The most significant results are listed below.

1. The scores on Facts decreased from previous years at each grade level. This is probably due to the fact that the number of items was increased. Better students scored higher, but most students were not able to do more than they had done in previous years. Hence, the overall percentage went down.
2. The scores for computation increased on 12 of the 14 subtests; they were lower only for sixth grade subtraction (from 81% to 78%) and sixth grade multiplication (from 67% to 56%). The better performance may be due to the fact that students were given a chance to try a greater number of problems than in previous years. The problems began with four or five simple problems and progressed gradually to more complex problems. This increase is encouraging.

3. The scores for word problems decreased slightly at the fifth grade (from 18% to 16%) and increased at the sixth grade level (from 25% to 31%). Given that there were twice as many problems as in previous years, this is a good performance.
4. The scores for both fractions and decimals decreased slightly. Since the number and type of problems were the same as in previous years, this is an actual decline.

Meyuns

The results for Meyuns School are in Table 3 on page 20. The main outcomes were similar to those at Harris School.

1. As at Harris, all of the subtests on Facts were lower than in previous years.
2. There was an increase in eight of the 14 subtests for computation and a decrease in six of the subtests.
3. The scores for word problems decreased at both the fifth and sixth grades.
4. The scores for both fractions and decimals decreased (at the sixth grade).

Maris Stella

Since this is the first year that the students at Maris Stella were tested, no comparisons can be made to prior achievement. Table 4 on page 21 shows the mean score, given in percent of correct responses, for students at the three schools. These will be discussed below.

Other Analyses

Table 5 on page 22 shows the correlations between the math skills and the total test score. Of all the skills on the test, division facts is most highly correlated to the total test score. That is, students who score highly on division facts also score highly on the total test while students who do poorly on division facts do poorly on the total test score. Hence, division facts is the best single indicator of mathematics proficiency as measured by this test.

A further analysis was done to determine if there were any differences in student achievement due to the sex of the students, the school which the students attended, and the grade level of the student. The results appear in Table 6 on page 23.

Gender. Table 6 shows that there were 255 girls and 266 boys in grades 2 through 6. The mean for the girls was 55% correct and the mean for the boys was 49% correct. A test of significance showed that this is a significant difference ($p<.0001$). Hence, we can conclude that girls outperform boys on the Mathematics Test. In an attempt to see where boys outperformed girls, tests of significance were conducted on each subskill. Table 7 on page 24 shows that girls outperformed boys on nearly every skill.

School. Table 4 shows the mean percent scores on each math skill for each grade level at the three schools. Second grade students at Harris did significantly higher on each subskill (marked by *H). There were no statistically significant differences at the third grade. The fourth graders at Maris Stella scored significantly lower on addition problems and subtraction problems. The fifth graders at Maris Stella scored lower on addition problems, but they scored higher on addition facts, subtraction facts, and word problems. The sixth graders at Meyuns scored significantly lower on addition facts, and the sixth graders at Maris Stella scored significantly higher on word problems. Table 5 shows that the average student at Harris had an overall mean of 55%, the average student at Meyuns an overall mean of 49%, and the average student at Maris Stella an overall mean of 50%. This is a statistically significant difference ($p<.01$). Thus, overall, the students at Harris did significantly better than the students at the other two schools.

Grade Level. Second graders averaged 48%, third graders 43%, fourth graders 49%, fifth graders 59%, and sixth graders 65%. This is a statistically significant difference ($p<.0001$). In other words, sixth graders do significantly better than the lower grade students. Since the tests are different at each grade level, and since we expect students to gain in competence as they mature, this outcome is an expected one.

Discussion of Grade 2-6 Results

Overall, some of the outcomes are higher and some are lower than in previous years, but since the test was slightly different, it is not possible to conclude that students scores have either increased or decreased. For example, the number of facts were increased from 30 to 42, and there was a decline in percent on every one of the facts tests. On the other hand, the number of computations increased (e.g., from six to 35 for addition), yet the percentage correct increased on 14 of the 16 subtests at Harris School and on nine of the 16 subtests at Meyuns. So, the results are mixed.

The fact that girls outperformed boys is probably the most interesting outcome. This result needs to be examined further to determine if this is a feature of this particular test or is a consistent trend across all curriculum areas. For example, do girls score significantly higher than boys on the high school mathematics entrance exam? Do they score higher on other subject matter tests?

Seventh and Eighth Grade Tests

In 1993 the seventh and eighth graders were tested for the first time as a part of this study. (Copies of the tests are available upon request.) The test consists of two parts. The first part is similar to the Grade 2 through Grade 6 test and includes the following skills and concepts: 35 addition problems, 35 subtraction problems, 35 multiplication problems, 21 division problems, eight fraction problems and eight decimal problems to compute (two on each of the four basic operations), and eight word problems to solve.

The second part of the seventh and eighth grade test contained 100 items which were a sampling of concepts and skills taken from the curriculum. The same skills appear at both seventh and eighth grades, but the problems are more difficult for the eighth graders. The topics included: finding the greater of two numbers, reducing fractions to lowest terms, changing improper fractions to mixed numbers, changing mixed numbers to improper fractions, changing fractions to decimals, changing decimals to fractions, solving algebraic equations, rounding off, solving three

types of percent problems, converting one measurement unit to another, finding square roots, squaring a number, finding the area of a rectangle, finding the perimeter of a rectangle, evaluating algebraic expressions, adding and subtracting measurement expressions, identifying odd and even numbers, and interpreting graphs. Table 1 lists the number of problems for each math skill.

Results for Grades 7 and 8

The results of the testing of each subskill appear in Table 8 on page 25. The data can be used by teachers to identify areas of both strength and weakness. For example, students in all schools do well with addition, subtraction, and reducing fractions, and they do poorly on rounding off, changing a decimal to a fraction, and solving the three types of percent problems. Since this is the first year of testing for seventh and eighth graders, no direct comparisons can be made with the results from previous years. However, since the 1993 seventh graders were the 1992 sixth graders at Harris and Meyuns, a comparison can be made on the computational items which were similar on both the 1992 and 1993 tests. Table 9 on page 26 shows that as sixth graders the students at Harris scored 61%, while as seventh graders they scored 70% on the same skills. Similarly, as sixth graders the students at Meyuns scored 60% and as seventh graders they scored 81%. This suggests that both groups are making progress.

School Differences

Statistical tests were run on each of the subskills to determine if the differences for each subskill are statistically significant. Asterisks (*) that appear in Table 8 indicate those subskills which are significant. At the seventh grade, there are statistically significant differences on only two subskills: the students at Maris Stella scored higher on word problems and on finding the perimeter of a rectangle. There was no significant difference on the total test score. There were nine significant differences on the eighth grade test; students at Harris scored higher on decimals, changing a fraction to a mixed number, changing a fraction to a decimal, solving algebraic equations, and evaluating algebraic expressions; students at Meyuns scored lower on word

problems; and students at Maris Stella scored higher on percent problems but lower on both changing mixed numbers to improper fractions and computing with measurement expressions. And finally, on the overall test, students at Harris scored significantly higher on the total test.

Problem Solving Differences

The ability to solve word problems is a major goal of mathematics education, and the test contained eight word problems. Two problems required one-step solutions, two required two-step solutions, two required three-step solutions, and two required four-step solutions. The outcome of the testing on word problems is interesting, for while the seventh and eighth grade students (combined) at Maris Stella scored lower than their counterparts on the total test, they scored significantly higher on Word Problems. This was an unexpected outcome, for it was assumed that the ability to solve word problems was dependent upon other (prerequisite) mathematical skills. To examine this result further, correlations were computed for all of the subskills to see what kinds of skills were correlated to word problems. [The table contains 25 subskills and is too lengthy to include in this report.] Using $r > .4$ as the criterion, the following six skills were determined to be significantly correlated with the ability to solve Word Problems: converting from one measurement unit to another ($r = .54$), solving percent problems ($r = .50$), evaluating algebraic expressions ($r = .47$), solving equations ($r = .47$), finding the perimeter of a rectangle ($r= .44$), and rounding off ($r = .40$). The solutions of these problems require higher order cognitive skills than do straight-forward computational problems, but the exact nature of their common element is not immediately clear.

This suggested that a factor analysis be performed to determine if the skills were related to one another. A principal factor analysis with promax rotation was performed on the data using squared multiple correlates as the commonality estimates. A factor analysis is a statistical procedure which takes all of the initial skills and groups them into a number of smaller sets. All of the skills in a given smaller set form a "factor," and theoretically the items are all measuring the

same factor. The results of the factor analysis appear in Table 10 on page 27. Using only correlations above .4, five factors were identified. Factor 1 consisted of addition, subtraction, multiplication, and division. These items appear to be measuring computational skills, and I have labeled it "Computation Skills." Factor 2 consisted of changing an improper fraction to a mixed number, changing a mixed number to an improper fraction, reducing fractions to lowest terms, changing a fraction to a decimal, and identifying odd and even numbers. These items mostly involve common and decimal fractions, and I have labeled it "Fractions Skills." Factor 3 consisted of five skills -- finding the perimeter of a rectangle, solving word problems, solving percent problems, converting one measurement unit to another, and solving equations. I have labeled this "Problem Solving Skills." It is difficult to find a common theme for the fourth factor which consisted of evaluating algebraic equations, changing decimals to fractions, squaring a number, and determining the greater of two numbers. Factor 5 consisted of only one skill, interpreting graphs. The six subskills at the bottom of the table did not correlate to any items. Thus, the test is measuring at least three identifiable factors of mathematical ability, Computation Skill, Fractions Skill, and Problem Solving Skill.

To determine if any of these factors was significantly related to the ability to solve word problems, these factors were entered into a stepwise multiple regression model. The items in each of these factors were first combined to form a factor score. For example, a new variable was formed for Factor 1 as follows:

Factor 1 = (addition + subtraction + multiplication + division) /126.

This tells the computer to form a new variable by adding up the scores of the five items and dividing by 126. The 126 is the sum of the number of problems for each subskills -- 35 problems for addition, 35 for subtraction, 35 for multiplication, and 21 for division. The same was done for the other four factors, and these scores were entered into a stepwise multiple regression model to determine the effects of these factors upon the word problems. The results appear in Table 11 on

page 28. Since we are using an acceptance criterion of P > .01, only Factor 3 has a significant effect upon word problems. This means that the common ability shared by each of these five items, whatever it is, accounts for nearly half (43.66%) of the variance in the word problems.

To summarize this analysis of word problems, the students at Maris Stella do significantly better on word problems than students at the other two schools, and the ability to solve word problems is related to the ability to solve equations, solve percent problems, convert one measurement unit to another, and find the perimeter of a rectangle. Whether or not this factor is related to general intelligence or proficiency in English (or some other ability) needs to be examined.

Sex Differences

Table 12 on page 29 shows a comparison of means between boys and girls for the seventh and eighth grades combined. Girls scored significantly higher on addition, subtraction, multiplication, division, decimals, and changing mixed numbers to improper fractions. When the total test scores are compared, girls do significantly better than boys.

Correlations

One final analysis was completed. Table 13 on page 30 shows the relationship of each subskill with Total Test score. The results show that of all subskills, the ability to solve division problems is most highly correlated to Total Test score. This means that students who scored high on the Total Test also scored high on division and that students who scored low on the Total Test scored low on division. Hence, the best single indicator of math ability as measured by this test is given by the student's score on division.

Summary and Recommendations

It appears that the students are doing about as well as they have done in previous years. The main results are as follows:

1. The second graders at Harris School scored significantly higher than the second grade students at Meyuns and Maris Stella. The differences at the other grades were not significant.
2. When the scores from grades 2-6 are combined, Harris School scored significantly higher.
3. When the scores from grades 2-6 are combined, girls scored significantly higher than boys.
4. When all schools are combined, sixth graders scored the highest, third graders the lowest.
5. The fifth and sixth grade students at Maris Stella scored significantly higher on solving word problems than their counterparts at the other two schools.
6. Of all the skills on the 2-6 test, the recall of division facts is most highly correlated with total test score.
7. The seventh graders at both Harris and Meyuns improved their scores on computational skills from 1992 to 1993 indicating that the students are making steady progress.
8. The eighth graders at Harris outperformed their counterparts in the other schools. The differences at the seventh grade were not significant.
9. Seventh and eighth grade girls outperformed the boys on total test performance.
10. The seventh and eighth grade students at Maris Stella scored significantly higher on word problems.

11. The ability to solve word problems is related to the ability to solve percent problems, the ability to solve algebraic equations, the ability to convert from one measurement unit to another, and the ability to find the perimeter the a rectangle, .
12. Of all the skills on the 7-8 test, computation with division is most highly correlated with total test score.
13. Computation Skill, Fractions Skill, and Problem Solving Skill were identified as three factors of math ability.

Ideally, several further analyses should be undertaken. In particular, the results of the Palau High School Mathematics Entrance Exam should be analyzed to determine if the results correlate to those of this test. For example, do girls outperform boys? Do the students at Harris outperform the eighth grade students in the other schools? Does the factor analysis of the Entrance Exam show a similar factor structure as the structure of this test? The answers to these questions would shed light upon the overall mathematics achievement picture in Palau.

It is recommended that the testing be continued again in 1994, with the provision that the lower grade tests include items more directly related to the school mathematics curriculum. A more detailed testing procedure will provide teachers with a better understanding of achievement.

Table 1

Number of Problems for each Math Skill

	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
Addition facts	42	42	42	42	42		
Addition computations	35	35	35	35	35	35	35
Subtraction facts		42	42	42	42		
Subtractions computations		35	35	35	35	35	35
Multiplication facts			42	42	42		
Multiplication computations			35	35	35	35	35
Division facts				40	40		
Division computations				28	22	21	21
Word problems				8	8	8	8
Fraction computations					8	8	8
Decimal computations					8	8	8
Greater than						8	8
Reduce fractions						8	8
Fraction to a mixed number						8	8
Mixed to improper fraction						8	8
Fraction to decimal						8	8
Solve equations						8	8
Round off						8	8
Decimal to fraction						8	8
Percent problems						6	6
Convert measurements units						6	6
Square root						4	4
Square a number						4	4
Area of rectangle						2	2
Perimeter of rectangle						2	2
Evaluate expressions						6	6
Compute measurements						2	2
Odd and even						2	2
Reading Graphs						2	2

Table 2

Harris Elementary School Data (Grades 2-6)
Mean Scores given in Percent

	1985	1987	1990	1991	1992	1993*
Second Grade						
Addition Facts	74	70	37	42	55	33
Addition Computation	79	46	52	52	58	82
TOTAL	76	66	40	44	56	55
Third Grade						
Addition Facts	49	71	76	50	52	38
Addition Computation	82	59	67	61	59	77
Subtraction Facts	27	42	64	38	43	18
Subtraction Computation	56	36	51	39	25	57
TOTAL	51	55	68	45	47	46
Fourth Grade						
Addition Facts	85	78	68	62	76	54
Addition Computation	93	78	78	80	73	76
Subtraction Facts	61	48	50	55	63	30
Subtraction computation	86	63	58	67	55	61
Multiplication Facts	64	66	52	54	73	41
Multiplication Computation	48	41	- - -	35	34	51
TOTAL	79	63	58	58	68	51
Fifth Grade						
Addition Facts	89	90	84	82	81	69
Addition Computation	98	80	82	79	83	85
Subtraction Facts	64	74	75	82	67	40
Subtraction Computation	77	82	71	81	67	68
Multiplication Facts	89	81	84	82	80	58
Multiplication Computation	54	51	60	51	48	58
Division Facts	74	71	68	70	73	56
Division Computation	36	28	27	34	30	32
Word Problems	- - -	14	20	19	18	16
TOTAL	82	74	73	74	71	58
Sixth Grade						
Addition Facts	- - -	96	92	90	92	77
Addition Computation	- - -	90	87	88	89	94
Subtraction Facts	- - -	89	83	93	82	56
Subtraction Computation	- - -	89	75	87	81	78
Multiplication Facts	- - -	94	87	87	86	68
Multiplication Computation	- - -	76	66	67	67	56
Division Facts	- - -	94	89	79	86	71
Division Computation	- - -	49	40	52	45	50
Word Problems	- - -	31	25	44	25	31
Fractions	- - -	65	50	67	52	43
Decimals	- - -	65	46	66	58	52
TOTAL	- - -	86	79	82	80	67

NOTE: * The 1993 test is different from the previous tests. Direct comparisons with previous years cannot be made.

Table 3

Meyuns Elementary School Data (Grades 2-6)
Mean Scores given in Percent

	1987	1990	1991	1992	1993*
Second Grade					
Addition Facts	42	42	30	44	22
Addition Computation	33	58	37	28	60
TOTAL	40	45	31	41	39
Third Grade					
Addition Facts	50	78	70	50	33
Addition Computation	54	61	67	60	78
Subtraction Facts	30	69	55	33	18
Subtraction Computation	31	35	61	39	55
TOTAL	40	69	63	43	44
Fourth Grade					
Addition Facts	69	98	80	70	50
Addition Computation	75	83	70	88	76
Subtraction Facts	56	82	67	50	35
Subtraction Computation	67	64	55	55	66
Multiplication Facts	56	66	39	50	30
Multiplication Computation	36	- - -	17	39	42
TOTAL	60	81	60	57	49
Fifth Grade					
Addition Facts	90	97	91	95	73
Addition Computation	81	85	84	87	83
Subtraction Facts	70	87	89	86	48
Subtraction computation	71	66	76	69	63
Multiplication Facts	82	88	72	73	55
Multiplication Computation	48	38	48	48	52
Division Facts	78	81	63	63	55
Division Computation	14	25	29	19	27
Word Problems	09	04	21	19	12
TOTAL	74	80	74	74	57
Sixth Grade					
Addition Facts	73	97	98	99	67
Addition Computation	84	89	89	87	71
Subtraction Facts	69	90	93	92	63
Subtraction Computation	74	81	83	88	67
Multiplication Facts	72	90	90	90	70
Multiplication Computation	52	55	66	59	50
Division Facts	76	86	85	88	60
Division Computation	22	24	51	39	41
Word Problems	05	22	22	32	26
Fractions	04	40	38	49	38
Decimals	39	35	57	52	47
TOTAL	64	80	83	83	61

* The 1993 test is different from the previous tests. Direct comparisons with previous years cannot be made.

Table 4

Harris, Meyuns, and Maris Stella Elementary 1993 School Data
Mean Scores given in Percents (Grades 2-6)

	HARRIS	MEYUNS	MARIS STELLA
Second Grade			
Addition Facts (42)	33 *H	22	23
Addition Computation (35)	82 *H	60	55
TOTAL	55 *H	39	38
Third Grade			
Addition Facts (42)	38	33	31
Addition Computation (35)	77	78	64
Subtraction Facts (42)	18	18	14
Subtraction Computation (35)	57	55	48
TOTAL	46	44	38
Fourth Grade			
Addition Facts (42)	54	50	51
Addition Computation (35)	76	76	55 *L
Subtraction Facts (42)	30	35	31
Subtraction computation (35)	61	66	37 *L
Multiplication Facts (42)	41	30	39
Multiplication Computation (35)	51	42	51
TOTAL	51	49	44
Fifth Grade			
Addition Facts (42)	69	73	88 *H
Addition Computation (35)	85	83	67 *L
Subtraction Facts (42)	40	48	66 *H
Subtraction Computation (35)	68	63	56
Multiplication Facts (42)	58	55	71
Multiplication Computation (35)	58	52	57
Division Facts (42)	56	55	66
Division Computation (28)	32	27	35
Word Problems (8)	16	12	37 *H
TOTAL	58	57	64
Sixth Grade			
Addition Facts (42)	77	67 *L	77
Addition Computation (35)	94	71	89
Subtraction Facts (42)	56	63	57
Subtraction Computation (35)	78	67	75
Multiplication Facts (42)	68	70	57
Multiplication Computation (35)	56	50	49
Division Facts	71	60	66
Division Computation (42)	50	41	45
Word Problems (8)	31	26	55 *H
Fractions (8)	52	38	39
Decimals (8)	43	47	42
TOTAL	67	61	64

*H indicates a score which is significantly higher ($p < .01$).
*L indicates a score which is significantly lower ($p < .01$).

Table 5

Correlations of Math Skills with Total Test Score for Grades 2-6

MATH SKILL	R
Division Facts	.80593
Subtraction Facts	.77308
Multiplication Facts	.76910
Addition Facts	.75232
Subtraction Problems	.75017
Addition Problems	.71341
Division Problems	.69107
Multiplication Problems	.68806
Decimals	.52793
Word Problems	.44754
Fractions	.24601

Table 6

1993 Percent Mean Scores by Sex, School, and Grade Level for Grades 2 - 6 at Harris, Meyuns, and Maris Stella

	N	% Score	Standard Deviation	Minimum	Maximum
Gender					
Male	266	49	16	10	91
Female	255	55	19	13	95
School					
Harris	276	55	16	9	95
Meyuns	108	49	18	6	93
Maris Stella	137	50	19	1	95
Grade Level					
Grade 2	88	48	13	1	79
Grade 3	123	43	14	6	69
Grade 4	108	49	17	9	91
Grade 5	118	59	16	16	95
Grade 6	84	65	16	30	95

Table 7

Percent Mean Scores for Boys and Girls
Grade 2 through Grade 6

SKILLS	N	FEMALE MEANS	N	MALE MEANS
Addition Facts	255	57 *	266	49
Addition Computation	255	78	266	74
Subtraction Facts	219	40	214	34
Subtraction Computation	219	64	214	58
Multiplication Facts	155	58	155	50
Multiplication Computation	155	54	155	52
Division Facts	100	67*	102	57
Division Computation	100	42 *	102	24
Word Problems	100	31	102	24
Fractions	40	46	44	45
Decimals	40	49	44	38
TOTAL	255	55 *	266	49

* Score is significantly higher ($p < .01$ level of significance).

Table 8

1993 Percent Mean Scores for Seventh and Eighth Grades at Harris, Meyuns, and Maris Stella

	SEVENTH GRADE			EIGHTH GRADE		
	Harris	Meyuns	Maris Stella	Harris	Meyuns	Maris Stella
Addition	95	97	91	96	95	95
Subtraction	84	92	81	94	95	95
Multiplication	63	68	60	72	65	63
Division	46	56	49	59	47	44
Fractions	58	61	48	76	75	61
Decimals	45	48	39	73*H	59	50
Word problems	34	40	61*H	54	35 *L	59
Greater than	63	65	60	58	48	54
Reduce fractions	89	91	79	95	87	77
Fraction to a mixed number	63	67	58	94 *H	64	60
Mixed to improper fraction	71	73	58	97	92	65*L
Fraction to decimal	35	41	36	89 *H	55	46
Solve equations	47	47	63	77 *H	29	50
Round off	20	25	23	44	16	43
Decimal to fraction	14	13	04	23	15	15
Percent problems	04	05	03	04	07	23*H
Conversion of measurements	32	41	48	48	38	53
Square root	59	47	56	52	73	73
Square a number	43	14	44	62	34	50
Area of rectangle	52	50	65	61	34	63
Perimeter of rectangle	18	19	44*H	50	50	35
Evaluate expressions	35	35	45	73 *H	36	42
Compute measurements	42	47	44	50	50	11*L
Odd and even	67	81	65	83	69	65
Reading Graphs	94	92	98	50	34	50
TOTAL	59	64	60	75*H	64	63

Note: *H means Significantly Higher at the $p < .01$ level of significance.
*L means Significantly Lower at the $p < .01$ level of significance.

Table 9

Comparison of 1992 Sixth Graders and 1993 Seventh Grade Students Mean Scores given in Percents

	HARRIS		MEYUNS	
	1992 as 6th Graders	1993 as 7th Graders	1992 as 6th Graders	1993 as 7th Graders
Addition Computation	89	95	87	97
Subtraction Computation	81	84	88	92
Multiplication Computation	67	63	59	68
Division Computation	45	46	39	56
Word Problems	25	34	32	40
Fractions	52	58	49	61
Decimals	58	45	52	48
TOTAL	61	70	60	81

Table 10

Factor Analysis of Seventh and Eighth Grade Math Skills

Skill	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Addition	.68116				
Subtraction	.82119				
Multiplication	.78105				
Division	.55463				
Change improper to mixed		.71548			
Change mixed to improper		.66679			
Reduce fractions		.65858			
Change fraction to decimal		.42575			
Identify odd and even integers		.40686			
Find perimeter of rectangle			.75976		
Word Problems			.71297		
Solve percent problems			.61977		
Convert measurement units			.47418		
Solve equations			.41337		
Evaluate algebraic expressions				.40210	
Change decimal to fraction				.62679	
Square a number				.48415	
Greater than				.42373	
Interpret graphs					.63599
Add or subtract measurements					
Decimals					
Fractions					
Round off					
Find square root					
Find area of rectangle					

NOTE: Only correlations 0.40 or higher are entered into the table.

Table 11

Stepwise Regression of Factors Related to Solving Word Problems

VARIABLE	PARTIAL R^2	MODEL R^2	F	PROB>F
Factor 3	0.4366	0.4366	137.1795	0.0001
Factor 2	0.0083	0.4449	2.6205	0.1073*
Factor 3	0.0166	0.4615	5.3916	0.0214*

* Note: Probabilities do not meet the $p < 0.01$ criterion.

Table 12

Percent Mean Scores for Items by Sex for Seventh and Eighth Grades

SKILLS	N	FEMALE MEANS	N	MALE MEANS
Addition	96	97*	83	93
Subtraction	96	92*	83	82
Multiplication	96	69*	83	59
Division	96	53*	83	44
Word Problems	95	45	83	46
Fractions	96	65	83	57
Decimals	96	55*	83	45
Greater than	96	62	83	56
Reduce fractions	96	90	83	83
Change improper to mixed	96	74	83	58
Change mixed to improper	96	81*	83	65
Change fraction to decimal	96	52	83	42
Solve equations	96	53	83	52
Round off	96	31	83	25
Change decimal to fraction	96	13	83	15
Solve percent problems	96	16	83	13
Convert measurement units	96	38	83	45
Find square roots	96	57	83	62
Square a number	96	45	83	42
Find area of rectangle	96	61	83	49
Find perimeter of rectangle	96	32	83	28
Evaluate algebraic expressions	96	45	83	41
Add or subtract measurements	96	38	83	41
Identify odd and even integers	96	77	83	63
Interpret graphs	96	71	83	79
TOTAL	255	55 *	266	49

* Score is significantly higher ($p < .01$ level of significance).

Table 13

Correlations of Math Skills with Total Test Score for Grades 7-8

MATH SKILL	R
Division	.77517
Multiplication	.73483
Decimals	.72005
Change fraction to a decimal	.70786
Subtraction	.70303
Evaluate algebraic expressions	.65121
Solve algebraic equations	.61599
Change improper fraction to mixed number	.60947
Round off	.58002
Addition	.56191
Fractions	.55731
Change mixed number to improper fraction	.55566
Word problems	.54757
Reducing fractions	.54619
Change decimal to fraction	.51608
Convert measurement to a different unit	.50111
Solve percent problems	.49020
Identify odd and even numbers	.46434
Square a number	.45432
Find perimeter of a rectangle	.37252
Add and subtract measurement units	.36700
Greater than, less than	.32154
Find square root	.29441
Find area of a rectangle	.15970
Interpret graphs	.05185